CBRN APR Concepts:Requirements Based on Existing National and International Standards

- Mechanical Connector
- Gasket, Mechanical Connector
- Breathing Resistance, Facepiece
- Dimensions and Weight, Mask Mounted (Chin Style) Filter
- Breathing Resistance
- Field of View
- Haze (Lens Abrasion)
- Carbon Dioxide
- Hydration
- Tolerance Analysis
- Practical Performance

CBRN APR Concepts:Requirements Based on Existing National and International Standards

- Filter Canister Test Challenge, Breakthrough Concentrations and Filter Efficiency
- Service Life
- Particulate / Aerosol Filter
- Service Life Testing, High Flow
- Fogging
- Communications

CBRN APR Concepts:Requirements Derived from other Standards/Specifications

Human Factors / Environmental Factors Requirements:

- Facepiece Field of View	EN 136
- Lens Abrasion	NFPA 1981
- Communications	NFPA 1981
- Hot Conditioning	Mil-STD-810 F
- Cold Conditioning	Mil-STD-810 F
- Humid Conditioning	Mil-STD-810 E
- Vibration	Mil-STD-810 F
- Mechanical Connector	EN 136, EN 148
- Breathing Resistance	42 CFR, Part 84
- CO_2	42 CFR, Part 84

CBRN APR Concepts: Environmental Conditioning

Purpose of Tests: Perform environmental storage, transportation shock and drop tests on the CBRN APR to qualify durability and to detect any initial life cycle failures modes that may occur from typical use.

Goal: To ensure APR provides adequate respiratory protection after being subjected to normal transportation, storage and rough handling conditions by the user

Environmental, Transportation and Rough Handling Durability Test Matrix

Test	Test Method	Test Conditions	Duration
Hot Diurnal	Mil-Std-810F 501.4	(35 ^{0}C/ 95 ^{0}F) to (71 ^{0}C/ 160 ^{0}F), 24 Hour cycle	3 Weeks
Cold Constant	Mil-Std-810F 502.4	Basic Cold, -32 ^{0}C (-24 ^{0}F), Constant	3 Days
Humidity	Mil-Std-810E 507.3	Realistic, Natural Cycle Humidity Profiles in the U.S. Mil-Std-810E; Table 507.3-II	5 Days "quick look"
Transportation Vibration	Mil-Std-810F 514.5	U. S. Roadway Vibration, Unrestrained: 12 Hours/axis 3 Axes: Longitudinal Axis, Vertical Axis and Transverse Axis.	Total duration: 36 hours = 12,000 miles
Drop Test: As Received Condition	Height of 3 feet	Unpackaged filter, 1 drop/filter on one of the 3 Axis: Major Axis Vertical, Air Outlet Port; Major Axis Horizontal; and Major Axis Vertical, Air Inlet Port.	After drops

CBRN APR Concepts: Test Sequence

- Reference Section 4.4.10 of September 16, 2002 concept paper
- CBRN APR system and filters shall be tested following environmental conditioning
- Testing of the CBRN APR system and filters shall follow the test sequence as defined in the concept paper

CBRN APR Concepts: Human Factor Testing/Breathing Resistance

Methods: **Per 42 CFR 84.122, 84.203, RCT-APR-STP-0004**

Procedure:

- **Headform tests with continuous air flow rate of 85 L/min.**

Requirements:

- **Inhalation Resistance w/ Particulate Filter (P100):**

	Face mounted	Non-face mounted
Initial:	**65 mm H_2O**	**70 mm H_2O**
Final:	**80 mm H_2O**	**85 mm H_2O**
Exhalation :	**20 mm H_2O**	**20 mm H_2O**

Facepiece Inhalation Resistance $\leq$ 10 mmH_20

CBRN APR Concepts: Human Factor Testing/Field of View

Methods: **Objective measure of Field of view (FOV)**

Procedure:

- **Adaptation of EN136, *"Full face masks for respiratory protective devices."***
- **FOV assessed methods equivalent to EN136, section 5.8.**
- **Express results as a percentage of the area of the 'natural' field of vision.**

Proposed Requirement: **EN136, 4.13.3**

Overall FOV ≥ 70 %

Overlapped FOV ≥ 20%

CBRN APR Concepts: Human Factor Testing Haze(Lens Abrasion)

Methods: **Per NFPA 1981 6.9, *Facepiece Lens Abrasion Test***

Procedure:

- **Haze tested in accordance with ASTM D1003, *Standard Test Method for Haze and Luminance Transmittance of Transparent Plastics,* with additions.**
- **Haze testing of multiple lens samples before and after abrasion.**

Requirements:

- **Average delta haze value of all samples ≤ 14%**

CBRN APR Concepts: Human Factor Testing Carbon Dioxide

Methods: **Per 42 CFR 84.97, RCT-APR-STP-0064, dated 4/26/2001.**

Procedure: Respirator mounted on a headform operated by a breathing machine. Breathing rate set 14.5 respirations per minute with a minute volume of 10.5 liters

Requirements:

Maximum allowable average inhaled CO_2 concentration ≤ 1 %.

CBRN APR Concepts: Human Factor Testing Hydration

Methods: **NIOSH RCT-APR-STP-0014 and**
US Army Chemical Agent Test Method(s)

Procedures: **OPTIONAL, Based on Configuration of Application**

Analyze drinking tube leakage on dry drinking tube valves, seats and seals.

NIOSH method: Subjected to suction of 75mm water column height

Requirements:

Leakage between valve and valve seat shall not exceed 30ml per min.

CBRN APR Concepts: Practical Performance

- Modified Laboratory Respirator Protection Level Test
- Use of Filter with Maximum Size and Weight Dimensions
- Limited Tariff (2 small/4 medium/2 large)
- Measured LRPL greater than 2000
- Subjective Wearer Assessment

CBRN APR Concepts: Human Factor Testing / Fogging

Method: **Human wear trials**

Conditions:

- **Cold: minus 21 °C (- 6 °F)**
- **Cool & humid: 15.5 °C (60 °F) at 75% RH**

No. of Test Participants: **2 per test condition**

Procedure:

- **Baseline visual acuity (Snellen eye charts or equivalent)**
- **4 hour respirator environmental conditioning.**
- **Respirator donning followed by test of visual acuity.**
- **5 min walk (4.8 km/hr (3 mph)): 2 min rest: 5 min walk: rest**
- **Measure visual acuity during rest periods.**

CBRN APR Concepts: Human Factor Testing / Fogging

Data Analysis:

- **Calculate *Performance Rating* scores for each visual acuity measure obtained during respirator testing.**
- **Average performance ratings for each individual subject.**

Proposed requirement: **Average *Performance Rating* ≥ 70%minimum for each environmental condition for each subject.**

Observation of respirator to function at low temperature.

CBRN APR Concepts: Human Factor Testing/Communications

Method: **Modified NFPA 1981 & ANSI**

Conditions:

- **Masked and unmasked (control) trials**
- **Constant background noise of 60 dB(A)**

No. of Test Participants: **3 Listeners & 5 Speakers**

Procedure:

- **Modified Rhyme Test (MRT) – phonetically balanced speech intelligibility test.**
- **One speaker and 3 listeners per MRT trial (50 stimulus words).**
- **Data obtained with and without respirator wear for both speakers and listeners.**

CBRN APR Concepts: Human Factor Testing/Communications

Data Analysis:

- **Listener performance calculated for each MRT trial**
- **Average individual listener's MRT scores for their masked and unmasked conditions.**
- **Calculate *Performance Rating* scores for each listener**
- **Average performance ratings of all 3 listeners.**

Proposed Requirement: **Average *Performance Rating* ≥ 70%**

CBRN APR Concepts: Mechanical Connector

- Interface between filter and respirator system based upon requirements of EN 148-1:1999
- EPDM gasket dimensions defined
- Maximum Filter weight of 500 grams
- Maximum Filter size: pass through 5 inch diameter opening with threaded connector perpendicular to the opening
- Tolerance Analysis of mechanical connector, filter thread, and gasket required in application

CBRN Standards Development

- Mechanical Connector (Interoperability Provision)
  - In Response to User Feedback
  - Applies to Consumable Filtration Devices
  - Definition of Requirements for Mechanical Connector
  - Definition of Performance Requirements

CBRN Standards Development

- Interoperability
- Requirements for Mechanical Connector
  - Threads IAW EN 148.1
  - Female Thread on Mask
  - Single Connector
- EN 148.1 Requirements
  - Thread Form
  - Sealing Gland Dimensions
  - Gasket Dimensions

CBRN Standards Development

- Gasket Material & Dimensions:
  - Sealing Configuration Not Specified
  - Material EPDM, 65 Durometer
    - M40 Military Mask Specification
  - Tolerance Analysis
    - Minimum Contact Area For Sealing
  - Specify Gasket Dimensions
    - ID = 25 mm max, OD 37.5 mm min.

CBRN Standards Development

- Interoperability Performance
  - Breathing Resistance – Mask
  - Canister Size Constraints:
    - Weight, Maximum
    - Physical Dimensions,
    - Modified LRPL:
      - Effectiveness of Mask Fit with Canister at Maximum Weight
      - Practical Performance

CBRN APR Concepts: Requirements from 42 CFR, Part 84, Applicable Sections

NIOSH 42 CFR Part 84 Subpart A,B,D,E,F, and G;

NIOSH 42 CFR Part 84, Subpart I, following paragraphs:

- 84.110 Gas Masks; description, Para a(1), a(2), and (b)
- 84.111 Gas masks; required components
- 84.112 Canisters and cartridges in parallel; resistance requirements
- 84.113 Canisters and cartridges; color and markings; requirements
- 84.114 Filters used with canisters and cartridges; location; replacement
- 84.115 Breathing tubes; minimum requirements
- 84.116 Harnesses; installation and construction; minimum requirements
- 84.117 Gas mask containers; minimum requirements
- 84.118 Half-mask facepieces, full facepieces, and mouthpieces; fit; minimum requirements, Para a(1), a(2), and (b)
- 84.119 Facepieces; eyepieces; minimum requirements
- 84.120 Inhalation and exhalation valves; minimum requirements
- 84.121 Head harnesses; minimum requirements
- 84.123 Exhalation valve leakage test

CBRN APR Concepts: Requirements from 42 CFR, Part 84, Applicable Sections

NIOSH 42 CFR Part 84, Subpart K, following paragraphs:

- 84.170 Non-powered air purifying particulate respirators; description
- 84.179 Non-powered air purifying particulate respirators; filter identification
- 84.181 Non-powered air purifying particulate filter efficiency level determination

CBRN Standards Development

- Questions?